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THE USE OF A FURNACE TECHNIQUE FOR STUDYING THE PYROLYSIS OF TOBACCO

C. I. Ayres and R. E. Thornton.
Research & Development Establishment, British-American Tobacco Company, Ltd., Southhampton, U.K.

ABSTRACT

A technique has been developed in which small samples of tobacco are pyrolysed in a furnace, and the yields of smoke components thus obtained are correlated with the deliveries obtained when the tobacco is burnt as a cigarette. Such a technique should include very rapid heating of the sample, and efficient collection of the pyrolysis products with avoidance of secondary pyrolysis. Following studies of various designs, these requirements have been met by the use of a short length mullite tube furnace. With this equipment, the production of phenols from tobacco has been studied. By examining the effects of sample size, pyrolysis time, pyrolysis temperature and carrier gas flow on the yield of phenols, standardized conditions have been determined at which a direct correlation can be made between the yields of phenols produced by pyrolysing a tobacco, and the product efficiency (E phenols) of the same tobacco, calculated from cigarette smoking data. Thus, it appears that the delivery of phenols from a tobacco in cigarette form can be predicted by the furnace technique. Initial studies are also reported on the possible precursors of phenols in cigarette smoke.

REVIEW BY M. L. GILFOYLE

A method was developed in which a direct correlation could be made between the yields of phenols produced by pyrolyzing tobacco and the product efficiency (E phenols) of the same tobacco calculated from cigarette smoking data.

A short length mullite tube furnace was used for pyrolysis. 150 ±25 mg of tobacco was placed in a porcelain boat and positioned in the furnace with a loading rod. The N_2 flow was regulated at 600 ml/min. The tobacco was heated rapidly to 800°C and the sample was pyrolyzed for 60 sec., although pyrolysis was complete in 20 sec. The pyrolyzate was swept off rapidly with the carrier gas to prevent secondary pyrolysis. The product was collected in a spiral trap at dry ice temperature. The trap was backed by a Cambridge filter.

There was a direct relationship between the size of the tobacco sample and the yield of the phenols. A large sample gave a large yield of phenols.

FIGURE 1

EFFECT OF SAMPLE SIZE ON YIELD OF PHENOLS

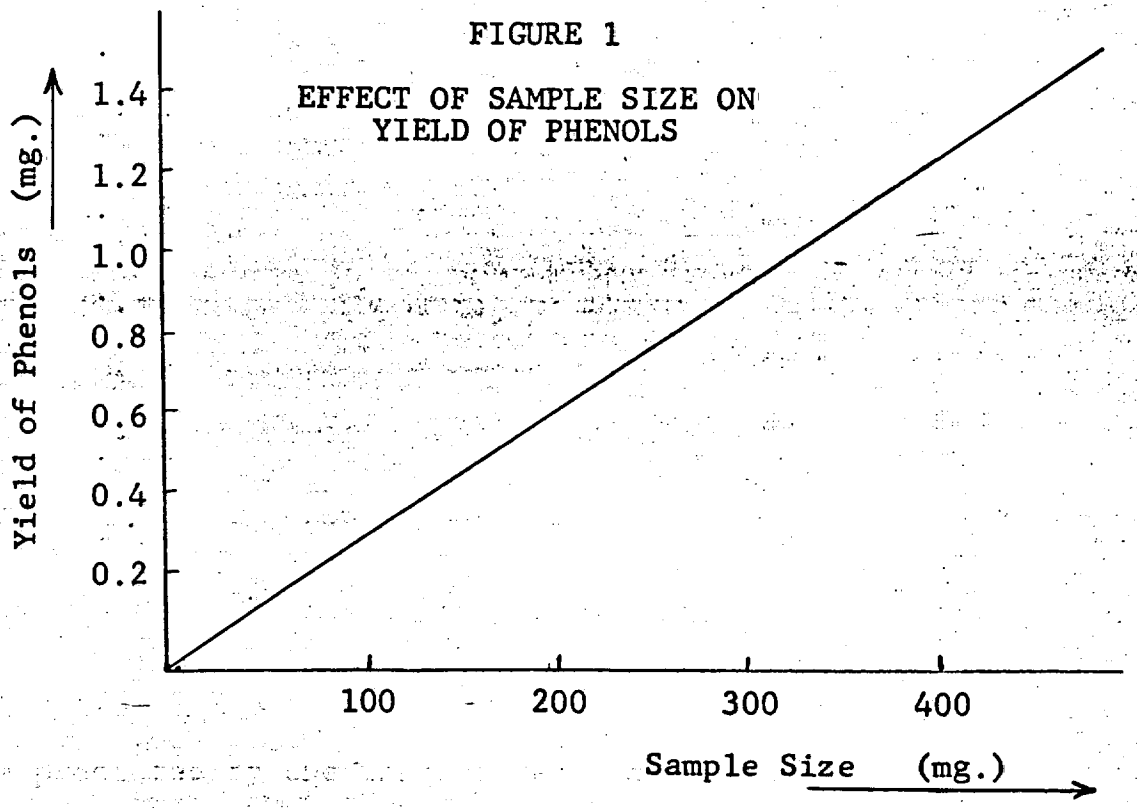
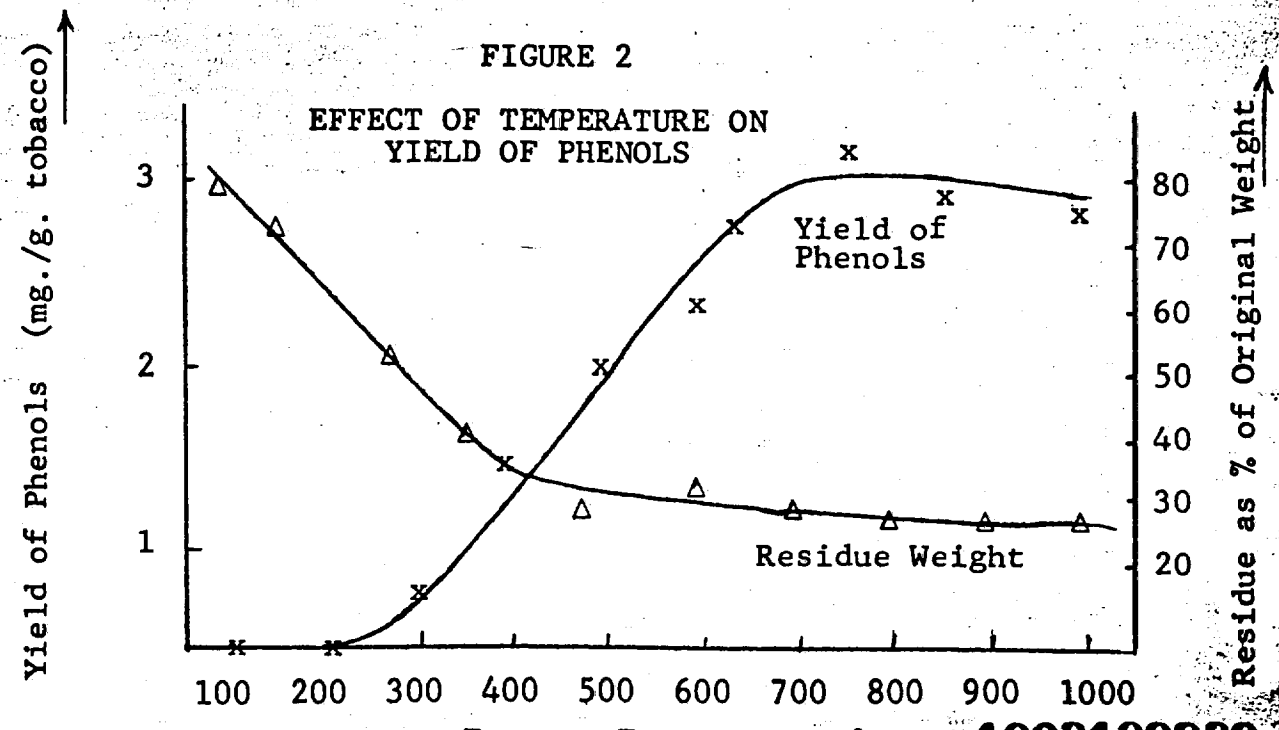


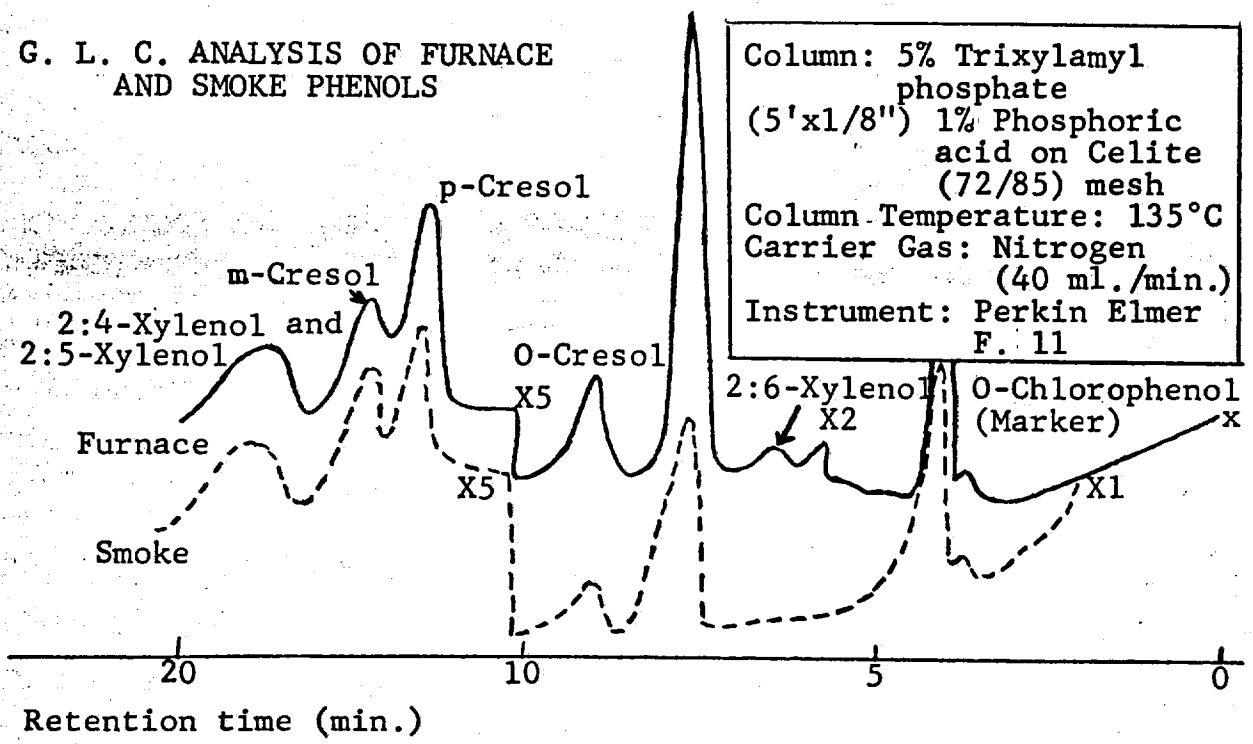
FIGURE 2

EFFECT OF TEMPERATURE ON YIELD OF PHENOLS



As shown in Figure 2, the yield of phenols was at a maximum at 800°C. The residue weight was at a constant value between 500° and 1000°C.

FIGURE 3

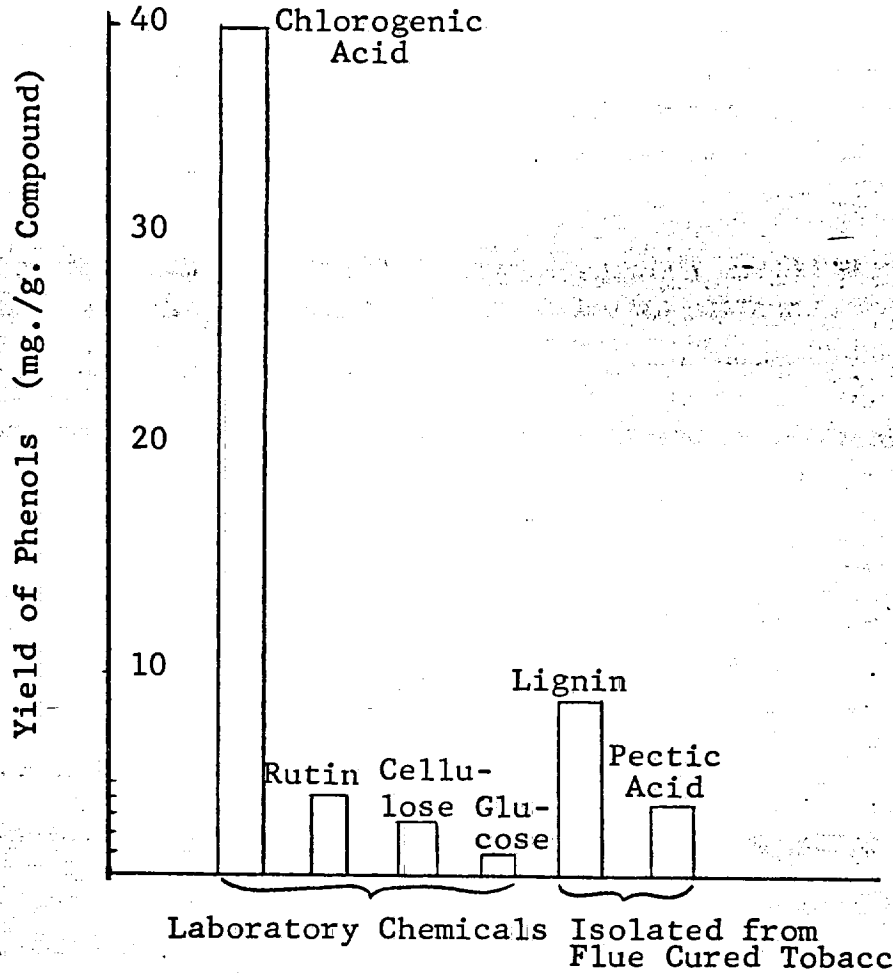


The large unmarked peak is phenol.

By this method the yield of phenols from tobacco when burned in cigarette form can be predicted by the furnace technique.

FIGURE 4

PRECURSORS OF PHENOLS



Chlorogenic acid appears to be the largest precursor of phenols in tobacco. Flue-cured tobacco contains free chlorogenic acid. When tobacco is pyrolyzed, chlorogenic acid converts to phenol at a much greater rate than do other components.

Addition of Chlorogenic Acid to the Cigarette

Tobacco	Additive	Deliveries of Phenol µg/cigt.
Burley	0% (control)	215
Burley	3% (chlorogenic acid)	255

The phenol deliveries were determined gas chromatographically.